The Centennial Patient Care Program: Binding Patient, Student, and Clinician-Teacher in a Learning Triad

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The University of Chicago is building a technology-based clinical environment to provide a longitudinal experience for patients and medical students. This environment uses an open systems, computer communication and information support network to forge an interactive education and care relationship between patient, medical student, and clinical faculty mentor. The project proactively addresses some of the most important activities required to reform both the health care and medical education systems: anchoring patient care in a generalist setting; educating medical students in outpatient medicine; fostering primary care as a career choice; and using medical informatics as a tool rather than as an end in itself. Moreover, the project effectively deploys concepts such as patient-centered education, student-based learning, and mentored teaching experiences. This paper reports the curricular, pedagogical, and technological motivations and framework under which the project was designed, and describes the process that a patient-student-clinician/teacher triad will experience as participants in this program.

INTRODUCTION

Changes in the practice of medicine have dramatically increased the volume of care delivered in outpatient settings. With increasing severity of illness on the inpatient services and shorter hospital stays, the outpatient clinic has been charged with acquiring a new and important role in medical education [1]. However, to date, the outpatient setting continues to be underutilized by medical centers for student teaching [2].

Both medical education (where the student or resident is the focus of attention) and primary care delivery (where the patient is the focus of attention) are currently experiencing an explosion of new methodologies and a multitude of new challenges. In clinical medical education, numerous calls have been made to provide students with a highly personalized, long-term association with a clinician/faculty mentor [cf. 3]. In primary care, authors have argued how an informed patient who is actively involved in the decision making process can improve the overall quality of care that he/she experiences [4]. Finally, and perhaps most significantly, both medical education and primary care have been impacted by the emerging field of medical informatics [5].

Existing curricular initiatives employing computer-based medical education approaches have usually focused on simulated exercises that a student performs (often alone) sitting at a computer [6]. The project described here assumes that such exercises are valuable (and indeed employs this approach in one project component), but additionally, emphasizes the use of a distributed computer-based model structured after the National Library of Medicine's Integrated Advanced Information Management Systems (IAIMS) effort [7]. Under this model, the technology infrastructure is used to enhance learning in actual encounters with real patients under the guidance of a clinical faculty mentor. Furthermore, the project assumes that teachers, students and patients can all continue learning through an ongoing association extending throughout the medical student's years in school.

The University Health Service (UHS) serves as the general medicine clinic, student and employee health service at the University of Chicago Medical Center (UCMC). The facility supports 70,000 visits annually from patients who represent the complete range of clinical issues, and come from all age groups and payer classes. Significantly, all of the patients of the UHS are under the care of full time clinical faculty -- in contrast to many institutions where the clinicians divide time between the academic clinic and private practice.

The primary care practice at the UHS represents an unparalleled resource in which to design and test new patient and student centered curricular and care programs. This paper presents one vision of an integrated technology-based environment that fosters clinical medical education in primary care. By fully integrating a patient-centered, dispersed site, learner-based curriculum, the project -- known as the Centennial Patient Care (CPC) Program -- will increase both student and patient satisfaction with and understanding of primary care in an academic setting.

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THE CENTENNIAL PATIENT CARE PROGRAM: RELATING TO THE PATIENT

The aims of the Centennial Patient Care Program are fourfold:

I. Provide medical students with a laboratory to apply principles of longitudinal patient care throughout their four year tenure;

II. Strengthen the cadre of faculty experienced in inculcating principles of longitudinal patient care as role models for career choices;

III. Establish a group of patients who are willing and able to provide feedback to students and teachers regarding application of principles of longitudinal patient care; and

IV. Provide patients with both quality care and an informed understanding of their experience in the primary care process.

A patient enrolled in the CPC Program benefits from consistent and continued access to a clinician mentor and medical student apprentice. The educational experience resulting from this synergism, for both student and patient, focuses on all aspects of care provided over an extended (i.e., three to four year) period of time rather than merely summarizing episodes of pathophysiology. The entire program is supported by a network infrastructure and workstation delivery system that allows clinicians, house staff, administrators, patients and students access to a diverse suite of information resources. Though workstations are being placed throughout the UHS, the heart of this environment consists of workstations located within combined faculty office / clinical exam rooms. In this way, the trio of clinician mentor, student apprentice, and Centennial Care patient have seamless access to a world of information and decision support utilities as a routine part of any patient encounter.

OVERVIEW OF THE CENTENNIAL PATIENT CARE PROCESS

The following narrative presents an overview of how patients, students, and clinician mentors will function within the CPC Program's administration. To date, not all of the features described are implemented and functioning. However, they are presented in total so the reader can understand how the strategic goals described above will be implemented in the UHS setting.

Patients are recruited to the Centennial Care Program when a request is made for an appointment in the UHS. At this point, a participant can choose to have his/her primary care guided by a medical student - faculty preceptor dyad. In exchange for the extra time spent in the teaching environment, a CPC patient gains access to a suite of "incentive" services not usually available to other patients, such as customized accounting, free parking, and the (monthly) Centennial Patient Care Program newsletter, as well as the intensified patient education experience.

So that each student by the time of graduation will have had experience with a "common core" of patients, nurses screen intake evaluations using a rough categorization of clinical issues to subsequently distribute patients. To enable students to begin working on this "common core" curriculum, selected members of the General Medicine faculty, working with an instructional designer and software support analyst, have begun collating (and in some cases, authoring) didactic, interactive and problem-based computer-based materials for all of the clinical issues embraced by the cadre of "common core" patient profiles. Applying the demonstrated strengths of computer-based medical education [8], the medical student can work on this curriculum either in or out of the clinical laboratory, at his/her own pace, and in an order which more appropriately relates to the patients being seen by the individual student.

A patient's participation in the CPC Program begins prior to the initial clinical visit with the patient using the *HealthQuiz* computer -- an interactive laptop video device on which branching questions are read and answered by a patient [9]. Upon completing the session, the *HealthQuiz* computer formats a personalized health history file which is subsequently loaded into the Centennial Patient Care database by a nurse or nurse's assistant; this file, along with a list of health care issues relevant to the patient (generated by the *HealthQuiz* utility), is then available to the medical student and clinician preceptor.

Centennial patients can, at the time of every clinical visit, peruse weekly electronic newsletters including *"In the News"* and *"Last Week, Your Student Doctor Learned." "In the News"* is a product of the UCMC Critical Appraisal course in which a small team of faculty, house staff, and students spend a month (in rotation) attending and critiquing conferences conducted in the UCMC as well as evaluating medical news items in the "lay press." The enabling support utility for this course is a work group software environment called the Virtual Notebook System (VNS™, see "Overview of the Centennial Patient Care Technology Infrastructure" below). The VNS™

allows shared multimedia notebooks to be maintained for UCMC conferences. More importantly, the VNS™ permits an ongoing dialogue among course participants involved in the critiquing process. For the Centennial patient, a key feature of these *"In the News"* notebooks is the course participants' relating of the conference materials to recent medical news items appearing in the lay press.

The *"Last Week, Your Student Doctor Learned"* bulletin contains brief bullet point summaries (in lay terms) of selected topics covered by medical students in their didactic courses during the previous week. Each course director supplies a weekly summary appropriate for the lay reader as well as a more technical summary for the faculty Centennial Care preceptor. The preceptors use the technical list to identify issues in the patient encounter that relate to material covered in the student's didactic courses. Centennial Care Patients use the summary listing to formulate questions and develop areas of interest to discuss with their student doctor and primary care clinician. In this way, the trio is involved in an ongoing learning process that educates them in areas far beyond the chief complaint which brought the patient to the clinic.

In the clinical encounter, a student meets with the patient and completes as much of the patient encounter as is appropriate for his/her level of learning (first year students focusing on the medical history, second year students on the physical exam, etc.).

As the student discusses the patient with the faculty member, resources available through the computer workstation can be quickly called up. These include such standard resources as Medline, Physician's Desk Reference, and clinical diagnoses expert systems, but also other learning utilities such as anatomical atlases, on-line texts, and digital video libraries. Finally, summaries from previous Critical Appraisal course discourses on various conferences, journal clubs and presentations in the UCMC, and summaries of didactic course material in the medical school curriculum are likewise all available through the single workstation interface.

This accessibility to information fosters interplay between basic science and clinical applications at all levels, fulfilling the mandate articulated in the GPEP report [1]. A healthy young man with a knee injury can become an inspiration for taking an accurate history for assessment of severity of knee injuries, of knee anatomy, of knee imaging studies, of mechanisms of inflammatory responses to mechanical trauma in joints, of pharmacology of non-steroidal anti-inflammatory agents, or of controversies in rehabilitation or of routine health maintenance schedules. Depending on the discussion, learner and preceptor may be equally or unequally naive. Having a rich resource base at hand encourages student and preceptor to take learning forays together, leading to a substantial "de-mystifying" of the learning process and to an emphatic denial of the student's passive role in medical education.

Likewise, the patient benefits from the seamless access and exposure to these supporting resources. Relevant anatomical images, illustrative radiological studies, and appropriate epidemiological graphic representations can all be located and shared with the patient.

At the conclusion of each encounter, informational materials appropriate for the patient's clinical problems can be queried, individualized to the patient, and printed for the patient to take home with him/her. Such materials can range from instructions on how to go to another clinical area in the UCMC, prepare for diagnostic studies, or take prescribed medications, to previously prepared overviews of common medical problems such as hypertension, acne, the common cold, and overuse syndromes of the knee.

Students can track a patient's progress in the UCMC via any Centennial-certified workstation with a campus network connection. Should appointments with other clinical areas be advised (cf. orthopedics clinic, physical therapy, radiology, or outpatient surgery), the student can attempt to coordinate such appointments with his/her class schedule so that student and patient can meet consultants together. Such linking of student and patient underlines the importance of the primary care provider as a "culture broker" for patients in an academic medical center.

Students also have access to illustrative information on Centennial Care patients for *ad hoc* use in the students' medical school courses. For example, a case history of a diabetic patient with graphically arrayed blood sugar values originating from a student's participation in the CPC Program could enhance didactic presentations on the pathophysiology of diabetes. This in turn would provide a more meaningful context in which to learn more about diabetes.

Traditional electronic mail and the Virtual Notebook System™ allow for lively dialog between student and preceptor even when the student is not "in clinic." Students can query preceptors about patients' laboratory results, about material culled from library work, and about the applicability of ongoing course presentations. With this information in hand, students can intelligently follow up with patients on

the telephone. This proactive communication between student and patient is meant to establish a pattern of interaction vital to primary care practice.

Although the initial laboratory for the Centennial Workstation Project is geographically centered in one outpatient area in the UCMC, the project's design allows for seamless dispersal to sites remote from the university. This dispersal, in turn, allows for early experience in community based settings without compromising commonalty of curriculum, of mentoring, and of intellectual challenge.

OVERVIEW OF THE CENTENNIAL PATIENT CARE TECHNOLOGY INFRASTRUCTURE

The technological design specifications for the CPC Program featured two driving motivations: (1) adherence to an open systems computing philosophy to allow disparate systems to be integrated and accessed via a consistent interface; and (2) support for collaborative applications to enable individuals to communicate and work together with others more effectively.

So that the CPC Program technology component could take advantage of work done at other academic medical centers, and to insure that technological components designed in-house for this project could transfer to other institutions, the project adhered to the model called for the by the National Library of Medicine's Integrated Advanced Information Management Systems (IAIMS) program [7].

From these motivations and requirements, the following hardware and software environment was developed.

Hardware Environment

The systems environment, technologies, and software development tools used in this project center on the requirements driving many similarly motivated efforts, including superior ease of use, high speed network protocols/cards/throughput to desktop, and adherence to industry standards (e.g., UNIX operating system, IEEE 802.3 networks, Simple Mail Transfer Protocol, Sun Microsystem's Network File System, NIS Naming Services, TCP/IP networking services, SQL database query languages, and ICCCM compliant window managers).

The working laboratory, developed at the University of Chicago's University Health Service, will ultimately consist of thirty office-examination rooms fitted with SunSparc IPX or LX workstations. Each workstation is configured with 32MB RAM, a 220MB Hard Drive, and a 17" color monitor. A third party file manager, IXI's Looking Glass™, is employed along with the Motif window system in order to provide end-users with a more intuitive desktop than provided by the native Sun windowing and desktop environment. This latter decision was prompted by that fact that many UHS faculty had previous familiarity and experience with the Microsoft Windows™ and Apple Macintosh™ operating systems.

Software/End-User Services

From a user-resource perspective, CPC Program participants have instant access to a wide range of software and on-line utilities, including:

•patient records (including patient demographics, laboratories, radiological findings, inpatient dictation summaries, outpatient visit notes, permanent problem lists, current medications, allergies and health maintenance flow sheets). This clinical care patient database is under development by the University of Chicago Hospitals Information Sector using the OACIS™ system from Bell Atlantic, Inc.;
•on-line texts (Robbins Pathology, run through the Macintosh emulator Liken™);
•image and digital video libraries (currently, a pilot project under development by the Biological Sciences Division Office of Academic Computing);
•expert diagnostic systems (DXplain, run through a terminal emulator session on the workstation);
•databases (Physician's Desk Reference™);
•local and remote bibliographic resources (Medline);
•internet information retrieval systems (X-MOSAIC);
•on-line library catalogue;
•billing and scheduling systems (currently, proprietary systems from Burroughs™ and IDX™, respectively, run through terminal emulator sessions on the workstation); and
•productivity software, including multimedia mail (Z-mail™), word processing (X-Word Perfect™), spreadsheet (WingZ™), and graphics (Island Draw™).

The centerpiece application used to organize and support many of the CPC Program's goals is the Virtual Notebook System™ developed by Baylor University and distributed by the Forefront Group, Inc. [10]. The VNS™ uses a notebook metaphor to provide users a distributed, multimedia hypertext system. This system is used to support work group collaborative projects that are rich in dynamic collections of information. Of particular relevance is that the VNS™ was developed in compliance with many of the above-mentioned industry standards and

was architected using a client/server layered model.

PROGRESS TO DATE

The CPC Program has recently completed prototype and initial implementation stages of development. This initial work centered on developing the technological infrastructure and the corresponding software environment within the UHS. To date, fifteen faculty office-examination rooms have been outfitted with CPC Workstations. Many of the software utilities previously described have in addition been deployed (the OACIS™ clinical care patient database and the billing and scheduling systems being notable exceptions). All CPC workstations and end-user services will be implemented by January of 1994.

Faculty reception of the system has been positive. Physicians have found that they can incorporate information retrieval into their ongoing clinical care and teaching responsibilities in a way that enhances both their efficiency and effectiveness. The small number of students and house staff who have participated in the pilot studies are eager to "take ownership" of the technology and immediately establish its relevance to their clinical practice. Patients are not put off by having their doctor turn to a screen for up to date information and spontaneously express increased confidence in this clinical care enterprise. Patients enjoy having tailored print-outs of both their own clinical information and of selected educational materials culled from the on-line resources.

To complete the CPC Program's components, efforts are now underway to implement remaining technological resources (the *HealthQuiz* computer) and software services (the clinical care patient database), and to establish an enrolled CPC patient and medical student cohort.

CONCLUSION

The Centennial Patient Care Program promises to provide powerful solutions to problems that currently prevent sufficient primary care education in students and patients. By binding together a patient-student-clinician/teacher triad that is supported by a pervasive information management and access environment, the Centennial Patient Care Program has the potential to fulfill many of the expectations placed on the medical education, primary care, and informatics communities. With the technological infrastructure in place and pilot curricular and patient care efforts underway, attention will next be turned to fully implementing and characterizing the effectiveness of this project in detail.

References

[1]. S. Muller. (Chairman) Physicians for the Twenty-First Century: The GPEP Report. Washington, D.C.: Association of American Medical Colleges, 1984.

[2]. Generalist Physician Task Force, AAMC Policy on the Generalist Physician. *Acad. Med.* **68**:1-6, 1993.

[3]. American Society of Internal Medicine. "Rebuilding Primary Care: A Blueprint for the future." Washington, D.C. March, 1993.

[4]. H. C. Sox, W. L. Morgan, V. R. Newfeld, F. Sheldon, and X. Tonsek. Subgroup report on clinical skills, in "Physicians for the Twenty-First Century," Report of the Project panel on the General Professional Education of the Physician and College Preparation for Medicine. *J. Med. Ed.* **59**:part II, November, 1984.

[5]. J. D. Meyers (Chairman). Medical Education in the Information Age. Proceedings of the Symposium on Medical Informatics. Association of American Medical Colleges, 1986.

[6]. M. R. Kidd, B. Cesnik, G. Connolly and N. Carson. "Computer-assisted learning in medical education." *Med. J. Australia* **156**:780, 1992.

[7]. T. Detre (Chairman). "Integrated Information Management Systems in Health Care." Association of Academic Health Centers, Washington, D.C. 1991.

[8]. G. O. Barnett. "Educational Uses of Computers." A Presentation at the Symposium on Medical Education in the Information Age. Sponsored by the Association of American Medical Colleges, Washington, D.C. March 7, 1985.

[9]. M. F. Roizen, D. Coalson, R. S. A. Hayward, J. Schmittner, R. A. Thisted, J. L. Apfelbaum, C. B. Stocking, C. K. Cassel, P. Pompei, D. E. Ford and E. P. Steinberg. "Can Patients Use an Automated Questionnaire to Define Their Current Health Status?" *Medical Care*, **30**:#5, *Supplement*, 1992.

[10]. G. A. Gorry, K. B. Long, A. M. Burger, C. P. Jung, and B. D. Meyer. "The Virtual Notebook System: An Architecture for Collaborative Work." *J. Org. Computing*, 1(3), 233-250, 1991.